

WE CLAIM:

- 1 1. A tubular structure having an aspect ratio of about 3 or more and
2 comprising an interior surface, said interior surface comprising a gaseous deposition
3 product comprising a substantially uniform coating.
- 1 2. The tubular structure of claim 1 wherein said coating comprises a
2 thickness of at least about 0.5 micrometers.
- 1 3. The tubular structure of claim 1 wherein said coating comprises a
2 thickness of at least about 2 micrometers or more.
- 1 4. The tubular structure of claim 1 wherein said coating comprises a
2 thickness of at least about 5 micrometers or more.
- 1 5. The tubular structure of claim 1 wherein said coating comprises a
2 thickness of at least about 15 micrometers or more.
- 1 6. The tubular structure of claim 1 wherein said gaseous deposition
2 product gaseous comprises carbon.
- 1 7. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises silicon.
- 1 8. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises chromium.
- 1 9. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises aluminum.
- 1 10. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises titanium.
- 1 11. The tubular structure of claim 1 wherein a gaseous precursor material
2 for said gaseous deposition product comprises a diffusion pump fluid selected from

3 the group consisting of polyphenyl ether; elcosyl naphthalene; *i*-diamyl phthalate; *i*-
4 diamyl sebacate; chlorinated hydrocarbons; *n*-dibutyl phthalate; *n*-dibutyl sebacate; 2-
5 ethyl hexyl sebacate; 2-ethyl hexyl phthalate; di-2-ethyl-hexyl sebacate; tri-*m*-cresyl
6 phosphate; tri-*p*-cresyl phosphate; and o-dibenzyl sebacate.

1 12. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises siloxane.

1 13. The tubular structure of claim 12 wherein said siloxane is polydimethyl
2 siloxane.

1 14. The tubular structure of claim 12 wherein said siloxane is pentaphenyl-
2 trimethyl siloxane.

1 15. The tubular structure of claim 12 wherein a gaseous precursor material
2 for said siloxane is a silicon containing diffusion pump fluid.

1 16. The tubular structure of claim 1 wherein a gaseous precursor material
2 for said gaseous deposition product comprises a metallic precursor.

1 17. The tubular structure of claim 16 wherein said metallic precursor is
2 selected from the group consisting of metal carbonyls, metal acetates, and metal
3 alkanedionates.

1 18. The tubular structure of claim 17 wherein said metallic precursor is
2 metal pentanedionate.

1 19. The tubular structure of claim 17 wherein said metallic precursor is
2 selected from the group consisting of tetrakis(dimethylamino)titanium,
3 hexacarbonylchromium, and hexacarbonylvandium carbonyl.

1 20. The tubular structure of claim 19 wherein said hexacarbonylvandium
2 carbonyl is selected from the group consisting of erbium III acetate, yttrium 2,4-

3 pentanedionate, erbium 2,4-pentanedionate, and N,N-(dimethylethanamine)-
4 trihydridoaluminum.

1 21. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises silane.

1 22. The tubular structure of claim 1 wherein said gaseous deposition
2 product comprises trimethyl silane.

1 23. The tubular structure of claim 1 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 24. The tubular structure of claim 2 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 25. The tubular structure of claim 3 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 26. The tubular structure of claim 4 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 27. The tubular structure of claim 5 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 28. A tubular structure having an aspect ratio of about 3 or more and
2 comprising an interior surface, said interior surface comprising a gaseous deposition
3 product comprising a substantially uniform amorphous carbon coating.

1 29. The tubular structure of claim 28 wherein said coating comprises a
2 thickness of at least about 0.5 micrometers.

1 30. The tubular structure of claim 28 wherein said coating comprises a
2 thickness of at least about 2 micrometers or more.

1 31. The tubular structure of claim 28 wherein said coating comprises a
2 thickness of at least about 5 micrometers or more.

1 32. The tubular structure of claim 28 wherein said coating comprises a
2 thickness of at least about 15 micrometers or more.

1 33. The tubular structure of claim 29 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 34. The tubular structure of claim 30 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 35. The tubular structure of claim 31 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 36. The tubular structure of claim 32 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 37. The tubular structure of claim 29 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 38. The tubular structure of claim 30 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 39. The tubular structure of claim 31 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 40. The tubular structure of claim 32 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 41. The tubular structure of claim 29 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 42. The tubular structure of claim 30 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 43. The tubular structure of claim 31 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 44. The tubular structure of claim 32 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 45. A tubular structure having an aspect ratio of about 6 or more and
2 comprising an interior surface, said interior surface comprising a gaseous deposition
3 product comprising a substantially uniform amorphous carbon coating.

1 46. The tubular structure of claim 45 wherein said coating has a thickness
2 of at least about 0.5 micrometers.

1 47. The tubular structure of claim 45 wherein said coating has a thickness
2 of at least about 2 micrometers.

1 48. The tubular structure of claim 45 wherein said coating has a thickness
2 of at least about 5 micrometers.

1 49. The tubular structure of claim 45 wherein said coating has a thickness
2 of at least about 15 micrometers.

1 50. The tubular structure of claim 46 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 51. The tubular structure of claim 47 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 52. The tubular structure of claim 48 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 53. The tubular structure of claim 49 wherein said substantially uniform
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or
3 less along its length.

1 54. The tubular structure of claim 46 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 55. The tubular structure of claim 47 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 56. The tubular structure of claim 48 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 57. The tubular structure of claim 49 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 58. The tubular structure of claim 46 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 59. The tubular structure of claim 47 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 60. The tubular structure of claim 48 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 61. The tubular structure of claim 49 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 62. The tubular structure of claim 45 comprising said interior surface
2 comprising at least one metal, and comprising a sequential gradient towards a center
3 of said tubular structure comprising:

4 silicon chemically bonded to said metal, forming a metal-silicide;
5 silicon cohesively bonded to said metal-silicide;
6 carbon chemically bonded to said silicon, forming silicon-carbide; and
7 carbon cohesively bonded to said silicon-carbide forming said substantially
8 uniform carbon coating.

1 63. The tubular structure of claim 45 comprising said interior surface
2 comprising at least one metal, and comprising a sequential gradient towards a center
3 of said tubular structure comprising:

4 germanium chemically bonded to said metal, forming a metal-germanide;
5 germanium cohesively bonded to said metal-germanide;
6 carbon chemically bonded to said germanium, forming germanium -carbide;
7 and
8 carbon cohesively bonded to said germanium -carbide forming said
9 substantially uniform carbon coating.

1 64. The tubular structure of claim 62 wherein said coating has a thickness
2 of at least about 0.5 micrometers.

1 65. The tubular structure of claim 62 wherein said coating has a thickness
2 of at least about 2 micrometers or more.

1 66. The tubular structure of claim 62 wherein said coating has a thickness
2 of at least about 5 micrometers or more.

1 67. The tubular structure of claim 62 wherein said coating has a thickness
2 of at least about 15 micrometers or more.

1 68. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises carbon.

1 69. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises silicon.

1 70. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises chromium.

1 71. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises aluminum.

1 72. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises titanium.

1 73. The tubular structure of claim 62 wherein a gaseous precursor to said
2 gaseous deposition product comprises a diffusion pump fluid selected from the group
3 consisting of polyphenyl ether; elcosyl naphthalene; *i*-diamyl phthalate; *i*-diamyl
4 sebacate; chlorinated hydrocarbons; *n*-dibutyl phthalate; *n*-dibutyl sebacate; 2-ethyl
5 hexyl sebacate; 2-ethyl hexyl phthalate; di-2-ethyl-hexyl sebacate; tri-*m*-cresyl
6 phosphate; tri-*p*-cresyl phosphate; and o-dibenzyl sebacate.

1 74. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises a siloxane.

1 75. The tubular structure of claim 64 wherein said siloxane is
2 polydimethyl siloxane.

1 76. The tubular structure of claim 64 wherein said siloxane is pentaphenyl-
2 trimethyl siloxane.

1 77. The tubular structure of claim 64 wherein said siloxane is a silicon
2 containing diffusion pump fluid.

1 78. The tubular structure of claim 62 wherein a gaseous precursor to said
2 gaseous deposition product comprises a metallic precursor.

1 79. The tubular structure of claim 78 wherein said metallic precursor is
2 selected from the group consisting of metal carbonyls, metal acetates, and metal
3 alkanedionates.

1 80. The tubular structure of claim 79 wherein said metallic precursor is
2 metal pentanedionate.

1 81. The tubular structure of claim 79 wherein said metallic precursor is
2 selected from the group consisting of tetrakis(dimethylamino)titanium, chromium
3 carbonyls (hexacarbonylchromium), vanadium carbonyls (hexacarbonylvandium
4 carbonyl).

1 82. The tubular structure of claim 81 wherein said hexacarbonylvandium
2 carbonyl is selected from the group consisting of erbium III acetate, yttrium 2,4-
3 pentanedionate, erbium 2,4-pentanedionate, and N,N-(dimethylethanamine)-
4 trihydridoaluminum.

1 83. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises silane.

1 84. The tubular structure of claim 62 wherein said gaseous deposition
2 product comprises trimethyl silane.

1 85. The tubular structure of claim 64 wherein said coating thickness
2 comprises a uniformity of about +/- 20% or less along its length.

1 86. The tubular structure of claim 65 wherein said coating thickness
2 comprises a uniformity of about +/- 20% or less along its length.

1 87. The tubular structure of claim 66 wherein said coating thickness
2 comprises a uniformity of about +/- 20% or less along its length.

1 88. The tubular structure of claim 67 wherein said coating thickness
2 comprises a uniformity of about +/- 20% or less along its length.

1 89. The tubular structure of claim 85 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 90. The tubular structure of claim 86 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 91. The tubular structure of claim 87 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 92. The tubular structure of claim 88 wherein said coating comprises a
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1 93. The tubular structure of claim 85 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 94. The tubular structure of claim 86 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

1 95. The tubular structure of claim 87 wherein said coating comprises a
2 hydrogen concentration of about 32 %.

- 1 96. The tubular structure of claim 88 wherein said coating comprises a
- 2 hydrogen concentration of about 32 %.